POLYSOL – Thermal and electrical performance assessment of a cost-effective polygeneration system
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Objectives

POLYSOL – Development of a polygeneration solar system for Zero Energy Building

The objective of POLYSOL is to develop and evaluate, both numerically and experimentally, a polygeneration system satisfying the electricity, cooling and heating needs of buildings.

Specific objective: Identification of thermal and electric energy consumption of the test facility throughout the year
Existing Test and Demonstration Facility (TDF)

General layout of the TDF

Installed electric capacity (measured)

- Cooling 0,36 kWel
- Heating 0,09 kWel
- Solar Field 0,18 kWel
- Data Acquisition 0,11 kWel
- Dissipation fan coil unit 0,75 kWel
Research methodology
Numerical model for thermal load assessment on the building
Research methodology
Numerical model validation

![Graph showing measured and simulated temperature over time]

- Measured Temperature
- Simulated Temperature

Time [h]
Temperature [°C]
Results

Yearly thermal performance

- Heat demand for heating
- Heat demand for cooling

Heating: 36%
Cooling: 64%
Results

Yearly thermal performance

![Graph showing yearly thermal performance with heat produced versus day of the year. The graph indicates fluctuations in heat demand and production throughout the year.](image-url)
Results
Yearly electrical performance

- Demand
- Production 8 P

Electricity [kWh]

Month of the year

- Data Logging 51%
- Solar Field 33%
- Cooling 4%
- Heating 2%
- Dissipation fan coil unit 10%
Results

Yearly electrical performance

Day of the year

PV Power - Power demand [kWh]
Results

Electrical performance in a selected summer day – example
Conclusions

Thermal Energy

\[ Q_{\text{solar, annual}} \approx 16 \text{ MWh}_\text{th} \text{ (about 6 times the demand)}; \]
\[ Q_{\text{demand, cooling}} \approx 64 \% \]

Shortages on the hourly and daily levels:

- highest cumulative thermal energy deficit (19 kWh\text{th}) for the 14\text{th} and 15\text{th} of February;
- TES will be used. About 37 kWh\text{th} excess on the 13\text{th} of February;

Electrical Energy

\[ W_{\text{elect, demand}} \approx 1.9 \text{ MWh}_\text{el}; \]
\[ W_{\text{elect, PV}} \approx \text{about 1.6}/1.7 \text{ times the demand (7 and 8 PV modules, respectively)}; \]

Shortages on the hourly and daily levels:

- highest cumulative electrical energy deficit (11 kWh\text{th}) for the 1\text{st} and 3\text{rd} of January;
- peak shortage \( \approx 0.8 \text{ kW}_\text{el} \) occurs in summer;
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The authors gratefully acknowledge the financial support of “Fundação para a Ciência e Tecnologia” (FCT – Portugal), through the research project POCI-01-0145-FEDER-030223 (“Development of a polygeneration solar system for Zero Energy Building”).